Understanding Lateral Mixing in the Ocean: 100 m to 1 km

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LONG-TERM GOALS

The long-range goals of this research are to understand the submesoscale processes causing horizontal dispersion of momentum and scalar quantities over the continental shelf. Phenomena that may lead to horizontal dispersion and variability include: meandering coastal fronts and jets, stirring by the wind and tide, and nonlinear internal wave packets.

OBJECTIVES

The specific objectives of the proposed research include:

- participation in a planning study group to develop a coordinated multi-year program,
- refurbishing our dye tracking equipment and instrumentation, and
- field testing of equipment and tracking procedures during surface dye releases

APPROACH

The Approach for each of the three specific objectives is given below.

Planning for future coordinated multi-year program. We will contribute to the planning effort lead by ONR for the DRI: *Scalable Lateral Mixing and Coherent Turbulence.* The planning will involve discussions and meetings with others in the group selected by ONR.

Refurbish equipment and instrumentation. Some of the equipment has not been used for more than 5 years and requires a thorough check out. Since there have been changes in technical personnel since our last dye experiment, this effort will give the opportunity to familiarize new personnel with the equipment.

Field test. The first field test will be a day trip aboard the R/V Elakha. This will serve as an initial shakedown of the key elements of the dye tracking equipment, including the dye pumping system, the Minibat towing operation, and the real-time display software. The second field test will be a 2-day cruise aboard the R/V Wecoma off the Oregon coast, using both the Minibat and the ship's CTD for dye tracking.

WORK COMPLETED

An initial round of discussions for planning the DRI have taken place, including a two-day meeting in Boston in late May 2008.

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14. ABSTRACT
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In preparation for the field tests, significant overhaul of equipment and instrumentation was accomplished, including: revamping the dye pumping system, upgrading the system used to mix the fluoroscein powder, testing sensitivity of new fluorometers, reconfiguring the CTD package used on the Minibat, checking Minibat wing operation, replacing mechanical hardware, upgrading the controlling computer system.

The day test on the 54' R/V Elakha occurred on 28 July about 10 miles off Newport, Oregon. Dye was release and was subsequently tracked with the Minibat CTD system. The two-day field test on the R/V Wecoma took place on 10-11 August. Two surface dye releases were done about 20 miles off Newport (see Figure 1). Tracking of the dye patch was done with both Minibat and the ship's CTD (tow-yo's). A fluorometer was also hooked up to the ship's flowthrough system to continuously sample water at 3 m depth.

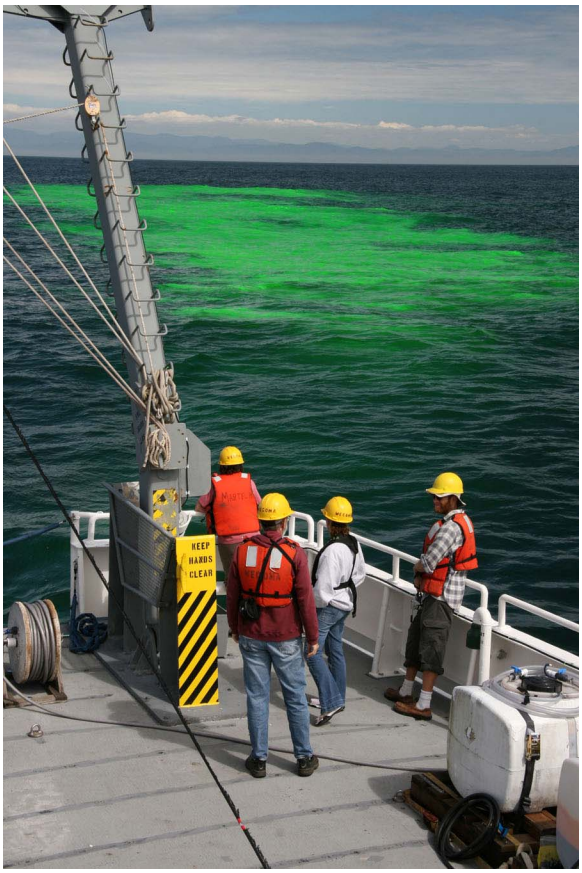

Figure 1. View of surface release of fluoroscein dye from R/V Wecoma off Newport, Oregon.

RESULTS

Much was learned regarding the conduct of a surface dye tracking experiment. We collected a significant amount of data (see example in Figure 2), and the analysis is just beginning. The first step, which is underway, is to determine the time lags between sensor responses so corrections can be made.

Our goal in further analysis is to determine if we are able to track a patch of dye adequately enough to learn something about the horizontal diffusion process. This analysis will also help us determine if

modifications should be made in our methods or equipment before conducting a future larger experimental effort.

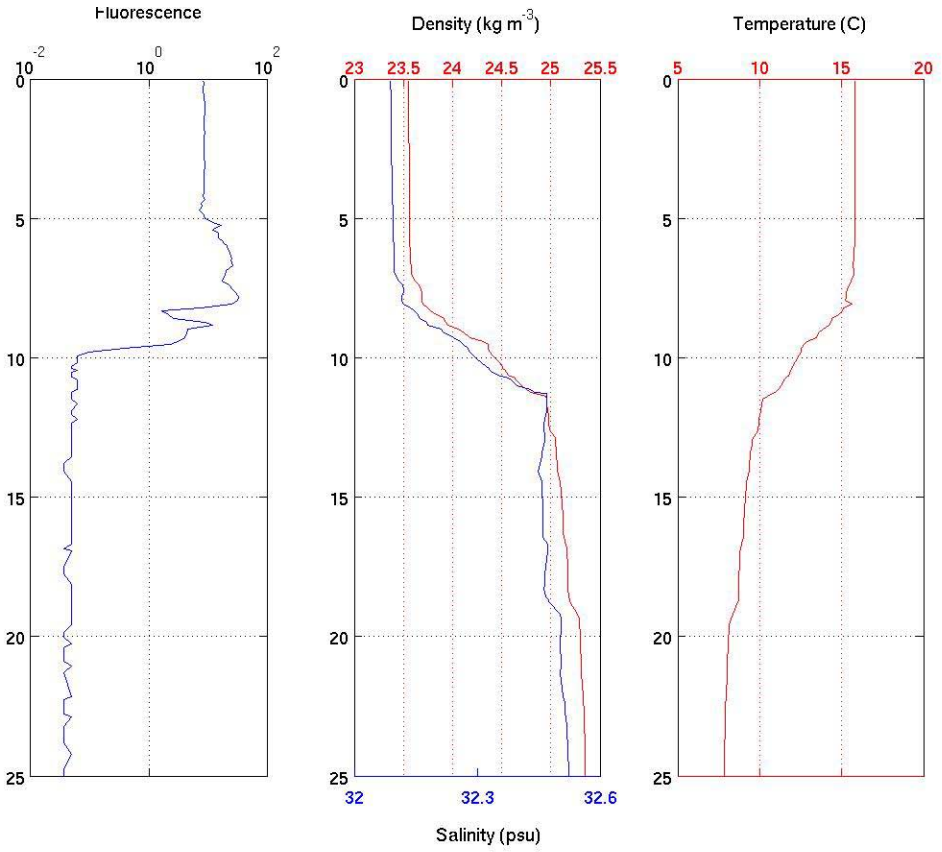

Figure 2. Vertical profile of dye fluorescence with salinity, temperature and density from the R/V Wecoma off the Oregon coast. Note the dye has been mixed throughout the mixed layer where it was injected and is beginning to mix into the pycnocline below.

IMPACT/APPLICATIONS

During the two-day Wecoma cruise we took the opportunity to take 6 oceanography graduate students and one undergraduate REU student, who may not have had the opportunity to experience sea-going operations. A local high school teacher, who is developing the study of oceanography as part of the curriculum, also came along.

RELATED PROJECTS

The observation and modeling of the coastal ocean off Oregon continues to be of great interest at OSU. Ultimately, improving understanding of the lateral mixing process will help in our ability to model coastal circulation.

While there are many projects relating to the coastal ocean at OSU, I am currently involved in making continuous observations from a mooring at a site 10 miles off Newport (NH-10). This effort is funded by NOAA as part of the ocean observatory system, specifically through the Northwest Association of

Networked Ocean Observing Systems (www.nanoos.org and www.orcoos.org) and by NSF, through the Center for Coastal Margin Observation & Prediction (CMOP) (www.stccmop.org). Near-real time data are being collected and distributed on the web.

I am also involved in CMOP (as Co-Director) with a major goal of trying to improve understanding of the river to ocean system. Submesoscale processes are important in trying to understand the mixing of the river plume with the coastal ocean.